Filterra

Technical Design Guide

Table of Contents

Introduction

Filterra is Ocean Protect's engineered high flow, high-performance biofiltration system. While it operates similarly to traditional bioretention, its high-flow media allows for a reduction in footprint (as low as 0.3% of catchment area). Filterra provides all the benefits of typical bioretention/filtration systems whilst being ideal for tight, highly developed sites, urban development projects, commercial parking lots, residential streets, and streetscapes.

Its small footprint reduces installation costs whilst still maintaining comparable life cycle costs compared with traditional bioretention. It can be configured in a variety of ways to integrate with other Water Sensitive Urban Design (WSUD) practices, whilst also enhancing site aesthetics. Additionally in can increase runoff reduction through infiltration below or downstream of the system.

Operational Overview

During a storm, stormwater enters the Filterra system through a pipe, kerb inlet, or sheet flow and ponds over the pre-treatment mulch layer, capturing heavy sediment and debris. Organics and microorganisms within the mulch layer trap and degrade metals and hydrocarbons. The mulch also provides a water retention function for the system's vegetation.

Stormwater then flows through the engineered high flow media filtering fine pollutants and nutrients. Organic material in the media remove dissolved metals and act as a food source for root-zone microorganisms. Treated water exits through an underdrain pipe or infiltrates (if designed accordingly).

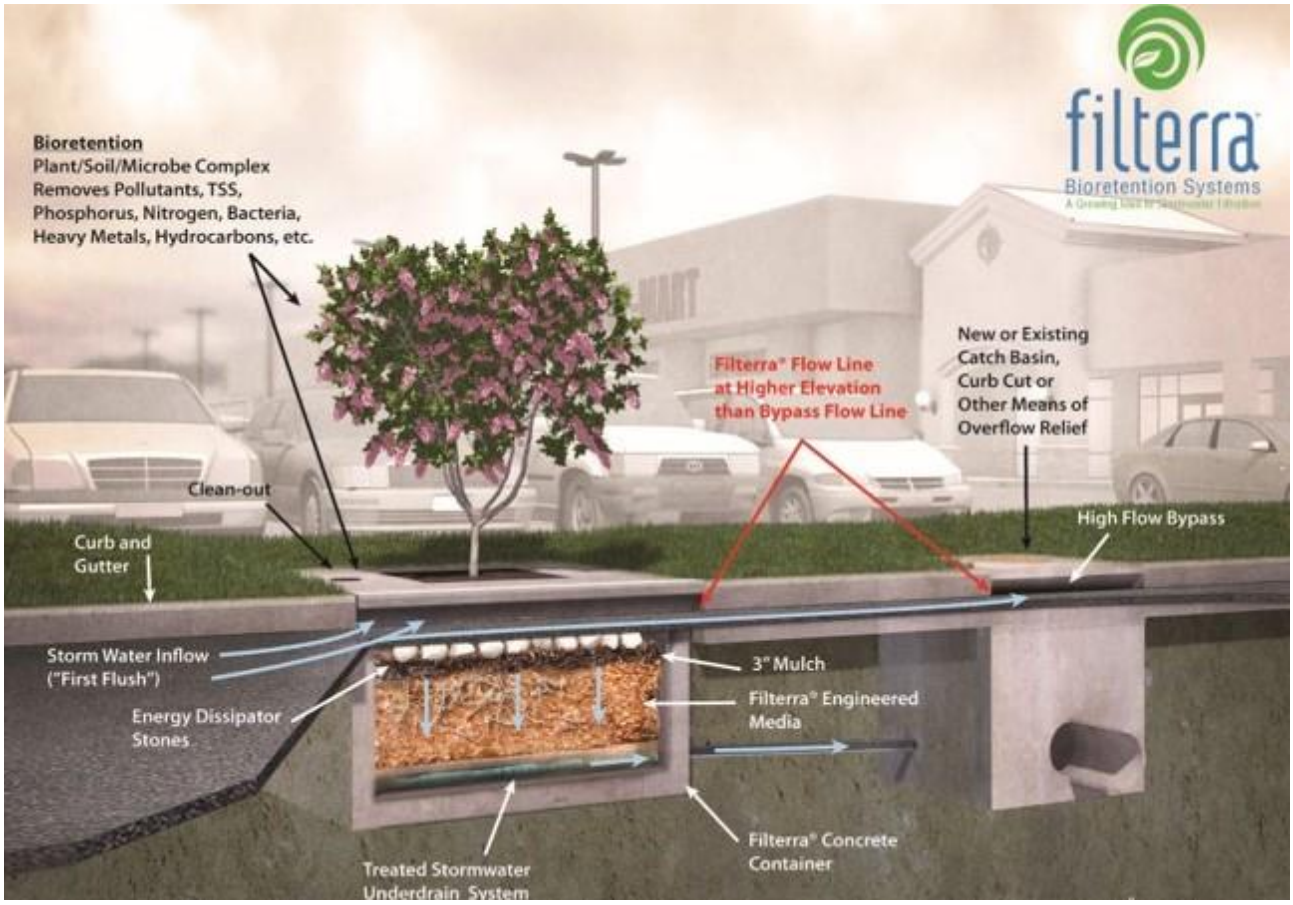

Figure 1: Filterra components

Microorganisms in the root-zone digest and transform pollutants into forms easily absorbed by plants regenerating the media's pollutant removal capacity. As roots grow they provide a hospitable environment for the root-zone microorganisms and penetrate the media, maintaining hydraulic conductivity.

The plant trunk and foliage utilise nutrients such as Nitrogen and Phosphorus for plant health, sequester heavy metals into the biomass, and provide evapotranspiration of residual water within the system.

Features

Similar to conventional bioretention a Filterra high flow bio-filtration system consists of multiple layers. They are the: mulch layer, Filterra media layer and underdrain layer (See Figure 2).

Please Note: A minimum 150mm of extended detention depth is required for Filterra

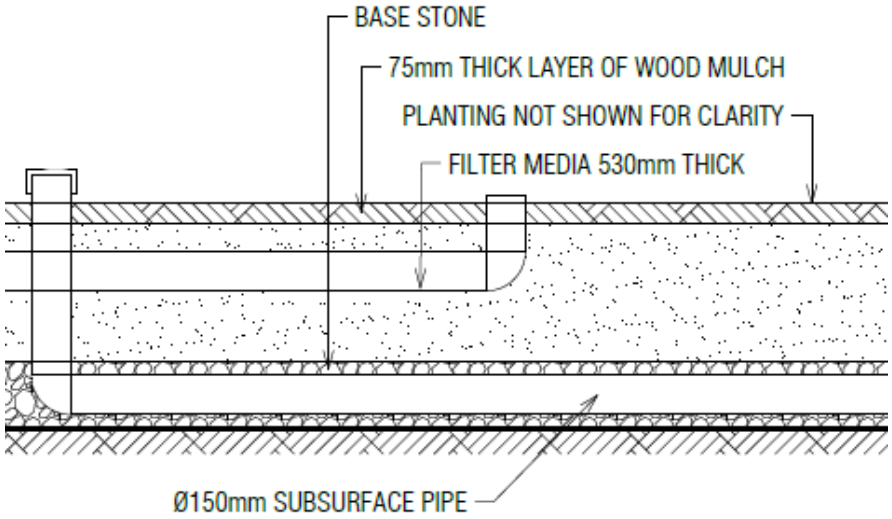

Figure 2: Filterra sectional view

Mulch Layer

A double shredded hardwood mulch layer is used to protect the media and assists with plant health. This mulch layer essentially acts as a Gross Pollutant Trap by capturing coarse sediment, litter and debris whilst maintaining the moisture in the media below. Typical this layer is 75mm thick.

Filterra Media

The Filterra media is a high flow, high quality media designed to provide optimised pollutant removal while maintaining excellent hydraulic capacity. Typically this layer is 530mm thick.

The media, manufactured by Ocean Protect under strict Quality Assurance and Quality Control processes, ensures rigorous calibration and testing through every step of new media production. No other biofiltration media in Australia is produced to same exacting methods or can provide the same level of consistency across a particular batch or different manufacturing facilities. Media blends are assigned batch numbers and receive a quality control certification. The following parameters are verified and controlled:

- PSD
- Moisture
- Organic content
- Bulk density
- Porosity
- Cation Exchange Capacity
- pH
- Fertility

Underdrain

The underdrain stone is tested for particle size distribution (PSD) to ensure permeability, proper bridging of media, and is further scrutinised to guarantee that no materials are present that could harm the vegetation. This layer ranges from 150-300mm thick, based on overall system size.

Planting

A range of native plants are available for the Filterra system. A database currently exists of over 15 different types of native shrubs, trees and grasses that have been successfully trialled in the Filterra system and are applicable to the east coast of Australia. Contact the Ocean Protect engineering team or your local representative for further information.

Configurations

The Filterra system can be arranged in a couple of ways such that it suits the site specific requirements for flowrate, hydraulics, accessibility and footprint restrictions. The standard configurations offered by Ocean Protect include pre-cast concrete tree-pits and bioscope in-situ construction.

Pre-cast concrete Filterra systems house the media and associated components within pits or vaults. These systems are simple to install as they arrive on site after being manufactured offsite to suit site specific requirements (pipe size, inlet/outlet orientation, levels etc.).

The Filterra tree-pit is installed along the kerb line at grade immediately upstream of a separate bypass pit. Once the storm event exceeds the design capacity of the Filterra the excess flow proceeds along the kerb and is collected by the bypass pit shown in figure 3.

In some cases, the Filterra tree-pit may need to be located with a grated drain entry or away from the kerb as shown in Figure 4. In this instance, a transition box is used to convey water from the kerb to the Filterra tree-pit.

Figure 3: Filterra tree pit – kerb inlet

Figure 4: Filterra tree pit – grated drain inlet

Typically, larger storms are bypassed around the Filterra system, however in some cases the bypass may be conveyed via a small pipe through Filterra tree-pit system, for example small downpipe applications, see Figure 5 below.

Figure 5: Filterra tree pit – with internal bypass

The Filterra bioscape system utilises impermeable liners placed within an excavation to create the media holding structure. The Filterra media, underdrain and associated distribution and collection systems are installed within this structure by Ocean Protect.

The finished edges of the system can have a variety of finishes, such as timber sleepers, logs, sandstone blocks, brick or blocks with capping stone or cast in situ concrete edging. Alternatively earth bunding is also possible provided there is delineation and no contamination between the surrounding soil and Filterra media, see figure 6 below.

Within larger Filterra bioscape systems the total filtration area is divided into “cells”. Each individual cell is design to have a maximum area of 90m2. Typically timber sleepers form the dividing walls between each cell, see figure 7 below.

Figure 6: Filterra bioscape – soft edging

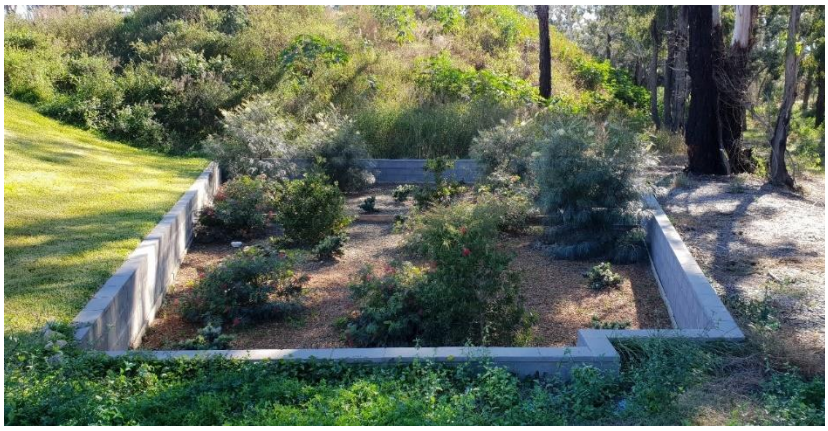

Figure 7: Filterra bioscape – hard edging

Figure 8: Filterra bioscape – hard edging

Performance and Select Approvals

While laboratory testing provides a means to generate hydraulic and basic performance data, all filtration devices should also be complemented with long-term field data evaluations. As a minimum, field studies should generally comply with a recognised field testing protocol, for example, the Technology Acceptance Reciprocity Partnership (TARP) or the Technology Assessment Protocol – Ecology (TAPE) in the USA.

To be considered valid, all field monitoring programs should be peer reviewed by a reputable third party and replicate local pollutant concentrations including soluble fractions of nutrients together with rainfall. Ocean Protect has undertaken such field testing both locally in Australia and overseas, copies of the supporting articles are available upon request.

Specifically Filterra has been accepted by some of the most stringent stormwater quality regulators around the globe including;

- Brisbane City Council
- Wollondilly Shire Council
- Washington State Department of Ecology (TAPE) GULD – Basic, Phosphorus
- New Jersey Department of Environmental Protection (NJ DEP)
- North Carolina Department of Environmental Quality (NC DEQ)
- Maine Department of Environmental Protection (ME DEP)

Please contact your Ocean Protect representative to obtain the StormFilter approval status in your area.

Maintenance and Activation

Every manufactured filtration device will eventually need routine maintenance. The question is how often and how much it will cost. Proper evaluation of long-term maintenance costs should be a consideration when selecting a manufactured treatment device.

Filterra maintenance is low-cost, low-tech and straight forward. Simply remove the accumulated litter and sediment plus the mulch layer and replace with a fresh 75mm layer of QA/QC mulch approved by Ocean Protect. There is no confined space entry or special tools required and the mulch does not have to be purchased from Ocean Protect.

With proper and routine maintenance, the engineered media should offer a comparable life span to traditional bioretention media. Routine maintenance is included by Ocean Protect for the first year after

activation. This includes a maximum of two visits to remove debris, replace mulch layer, and prune the vegetation.

For further information please refer to the Filterra Operations and Maintenance Manual.

Ocean Protect provides a full install and activation service for Filterra. This is undertaken by trained and certified personnel to ensure that the Filterra system is installed correctly and that all of the necessary requirements are met (supervised installation options are also available for special circumstances). Included in the full installation service is the onsite activation of the Filterra system by Ocean Protect. This will only occur once the site is fully stabilised and all drainage lines have been flushed clean. Up until the point of activation it is the responsibility of those on site to ensure adequate protection of the system.

Design Basics

The design requirements of any Filterra system is detailed in 3 typical steps.

1. Hydraulic Design
2. Water Quality Design
3. Planting Design

1. Hydraulic Design

All Filterra systems must be designed to ensure that the hydraulic requirements of the system are met without adversely impacting the upstream hydraulics (limiting the likelihood of localised flooding). All Filterra systems must be designed in an offline configuration.

Kerb inlet Filterra systems require a bypass pit directly downstream to ensure higher flows are bypassed along the kerb line. Ensure the kerb inlet to Filterra system is on-grade (no sag) and that the flow enters the unit parallel to the kerb line or adjacent to the inlet to eliminate any likelihood of scour.

Base flow or constant dry weather flows will blind and foul any biofiltration system as a result of having organic material and nutrients within the media. Be sure to consider if a low-flow bypass is required for your system. Special surface treatments such as recessed converter slabs are available for applications that are required to match a paved or landscaping scheme. Contact Ocean Protect engineering team for further details.

2. Water Quality Design

Ocean Protect recommends and uses the widely endorsed Model for Urban Stormwater Improvement Conceptualisation (MUSIC), which makes it easy to correctly sizing an appropriate StormFilter system for your site.

A complimentary design service which includes MUSIC modelling is provided by the Ocean Protect engineering team. Simply email your project details to design@oceanprotect.com.au or alternatively you can always call one of our engineers for a discussion or to arrange a meeting in your office. The team will provide you with an efficient design containing details of the devices required to meet your water quality objectives together with budget estimates, product drawings and the MUSIC (.sqz) file.

Alternatively, you can download the MUSIC treatment nodes for the Ocean Protect products from our website (www.oceanprotect.com.au).

The Filterra® biofiltration systems can be modelled in MUSIC in one of two ways. These are;

1. Firstly, using a bioretention treatment node as shown in table 1 below, or

2. Using the generic approved node by your local jurisdiction.

Parameter	Unit	Value	Comments
Inlet properties			
Low-flow bypass	m^3/s	0	All flows enter system.
High-flow bypass	m^3/s	100	Default value. Overflow of high flows determined by system storage.
Storage properties			
Extended detention depth	mm	150	Cannot be less than 0.3% of catchment
Surface area	m^2	XXX	
Filter and media properties			
Filter area	m^2	XXX	As above.
Unlined filter media perimeter	m	N/A	Zero exfiltration assumed.
Saturated hydraulic conductivity	mm/hour	3550	Design rate.
Filter depth	m	0.53	Standard spec.
Total Nitrogen (TN) content	mg/kg	200	Standard spec. from laboratory tests of Filterra® filter media.
Orthophosphate content	mg/kg	0.1	Standard spec. from laboratory tests of Filterra®. Result is <0.1 (LOR)
Infiltration properties			
Exfiltration rate	mm/hr	0	Zero exfiltration assumed.
Vegetation properties			
Plant selection	-	'vegetated with nutrient ineffective plants'	Standard spec.
Outlet properties			
Overflow weir width	m	XXX	Estimated on system size.
Underdrain present	-	Yes	
Submerged zone with carbon present	-	No	

Table 1. Filterra Biofiltration node properties in MUSIC.

When designing/modelling a Filterra system in a previously approved jurisdiction, two (2) treatment nodes are typically utilised in series. These are the detention/sedimentation node located immediately upstream of a generic treatment node.

For the detention node there are a number of parameters that need to be entered to ensure the node is representative of its effectiveness within the treatment train: surface area, extended detention depth, k-values, equivalent pipe diameter etc. For guidance on all of these variables please refer to the Filterra design pack or contact Ocean Protect.

For the Filterra system the generic treatment node is utilised with relevant removal efficiencies inserted. These parameters can vary based on the jurisdiction (authority) of your project, relevant details can be obtained from Ocean Protect. The high-flow bypass figure is adjusted within the node to represent the treatable flow rate required to obtain water quality objectives. Once finalised this figure can be divided by the relevant square meter flow rate for Filterra to obtain the filtration surface area required.

All details such as drawings, specifications and maintenance manuals can also be downloaded for integration into your project's documentation. Additionally the Ocean Protect team is available to review your model and provide additional assistance and guidance on the configuration of the StormFilter system(s) for your project.

3. Planting Design

Filterra systems require both vegetation and media to function properly, when evaluating the quantity and size of plantings it is essential that system aesthetics are weighed against the overall perform of the system

For appropriate planting, Filterra high flow rate biofiltration systems must have the following:

- Adequate space to perform maintenance
- Adequate plant spacing to prevent roots from matting together
- Adequate sunlight necessary to aid in evapotranspiration after storm events whilst minimising the drying out of the media

A combination of trees, shrubs and grasses is recommended and Ocean Protect has a comprehensive database of approved plants. Approved plants take into consideration attributes like hardiness, longevity and water quality benefits along with the expected adult size and growing region. For guidance on the available options please refer to the Filterra design pack or contact Ocean Protect.

Support

• Drawings and specifications are available at **www.oceanprotect.com.au**
• Site-specific design support is available from our engineers.

Ocean Protect provides site solutions for the civil engineering industry.